Harnessing the Audio Capabilities of QuickTime 7

Session 201

These are confidential sessions—please refrain from filming or taking pictures.

Graphics and Media

Harnessing the Audio Capabilities of QuickTime 7

Daniel Steinberg and Brad Ford
QuickTime Engineering

http://developer.apple.com/wwdc2005/

Introduction

- Hints and tips for supporting new audio capabilities
  - QuickTime Player features
  - Sample applications
  - Code examples
- Not all new features will be covered in depth

QuickTime Audio	Graphics and Media Lab Wednesday 9:00AM	Hands On
Core Audio	Graphics and Media Lab Wednesday Noon	Hands On

What You'll Learn

- New multi-channel audio features
  - Creating and labeling multi-channel content
  - Supporting channel layouts in your application
  - Capturing multi-channel content
- Audio APIs for movie and track control
  - e.g., Audio Gain property
  - Establishing property listeners
- Movie Audio Extraction APIs
- Audio Capture using SGAudioChannel

Overview

What’s new in QuickTime Audio

http://developer.apple.com/wwdc2005/

QT7 Audio Enhancements

Audio context

- Sound tracks are layered on Core Audio
  - New APIs reflect Core Audio conventions
  - Backward-compatible: existing media and APIs just work
- MPEG and Streaming Tracks…not yet
  - Toll-free bridging of some APIs
- Movie-level API for setting the playback device
- Pitch-preserving varispeed
  - Enabled by default in QTKit, QTActiveX control, QuickTime Player
    - Other apps may opt-in using `NewMovieFromProperties`
  - Used for playback rate and scaled edits

QT7 Audio Enhancements

High resolution audio support

- Media sample rates to 192 kHz
- Media sample bit depth to 24-bit integer and 32-bit float
  - Core Audio processing is 32-bit float
- Multi-channel support
  - Audio channels may be distributed among multiple sound tracks
  - Spatially labeled channels are mixed and routed
  - Playback of up to 24 channels is supported
- Playback and capture supported on most pro-audio interfaces

QT7 Audio Enhancements

Extraction and export

- Audio extraction provides one-stop shopping for movie audio data
- Uses the same code path as playback
  - WYHIWYG
- Audio export is built on audio extraction
- Multi-threading support
  - See QuickTime Tech Note 2125
- StdAudio compression configuration component
  - Replaces StdSound component

QT7 Audio Enhancements

Property-based APIs

- Movie and track properties
  - Gain and mute
  - Balance
  - Channel layout
- Convenience functions: movie and track APIs
  - Gain, mute, balance
  - Audio metering
- QTKit and QuickTime Player use properties extensively

QT7 Audio Enhancements

Audio capture

- Allows taps in the audio chain
  - Integrated with Core Audio
- Multi-device capture and preview
- Sophisticated routing and mixing of tracks and channels
- High-resolution audio support
  - Capture from multi-channel interfaces and decks
  - On-the-fly format conversions

Demo

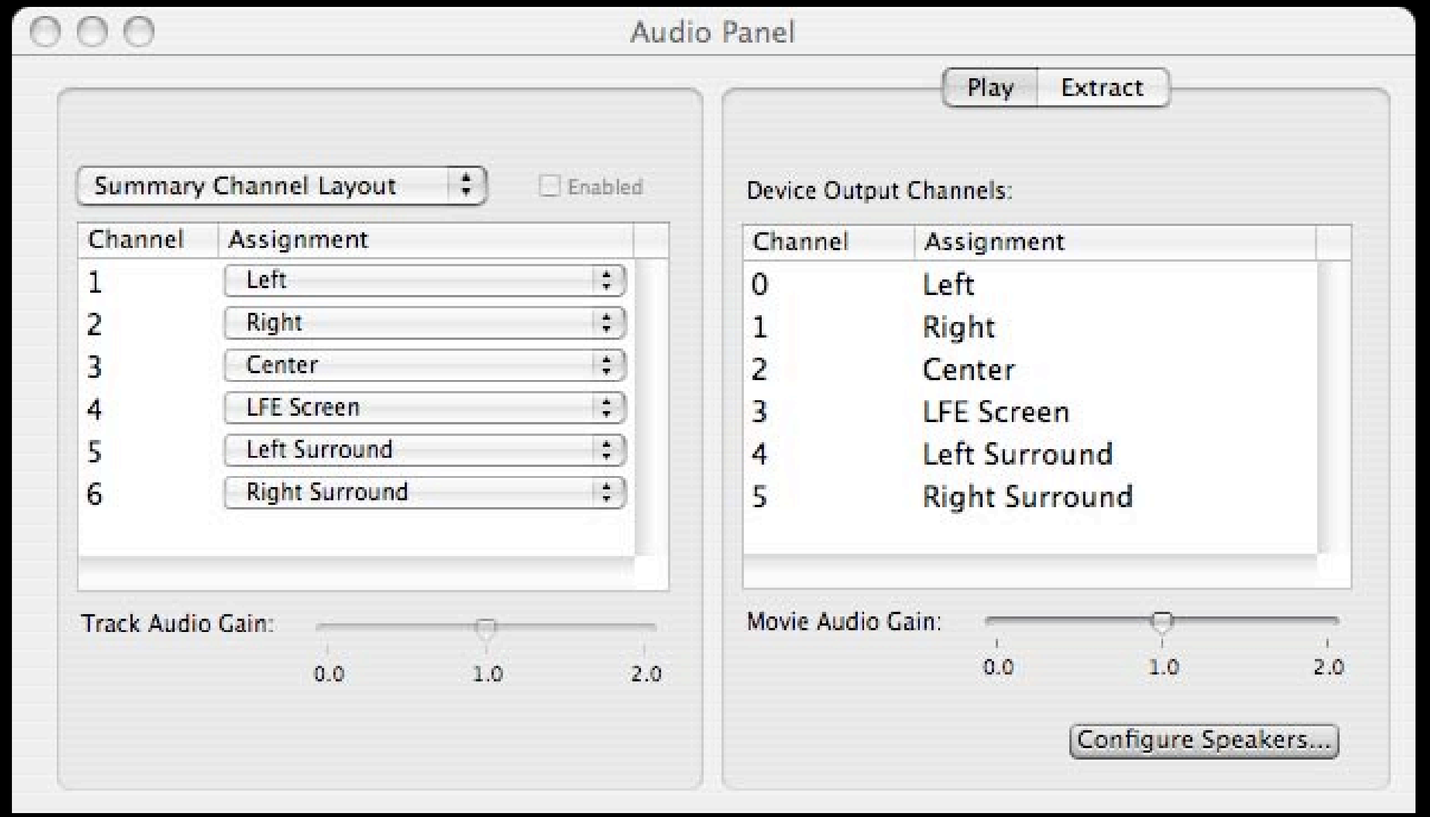
Multi-channel support in QuickTime Player

http://developer.apple.com/wwdc2005/

Coding Examples

Audio Routing Panel in Cocoa Sample Player

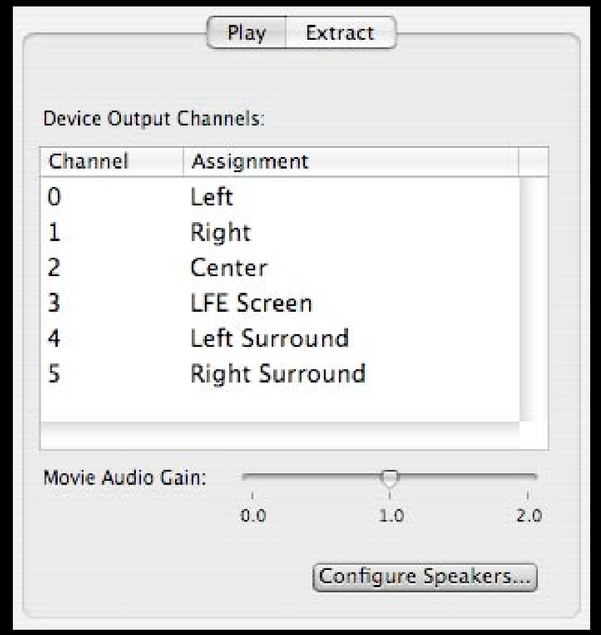
Thanks to Sayli Benadikar
QuickTime Engineering


Audio Panel
Play
Extract
Summary Channel Layout
Enabled
Channel
Assignment
1
Left
2
Right
3
Center
4
LFE Screen
5
Left Surround
6
Right Surround
Track Audio Gain:
0.0
1.0
2.0
Device Output Channels:
Channel
Assignment
0
Left
1
Right
2
Center
3
LFE Screen
4
Left Surround
5
Right Surround
Movie Audio Gain:
0.0
1.0
2.0
Configure Speakers...

Audio Routing Panel

Device Overview Pane

- Displays the speaker assignments of the output device
- Invokes Audio MIDI Setup to configure the device
- Movie Audio Gain slider
  - Property listener keeps the UI in sync



Audio Gain

- Gain is multiplicative
  - 1.0 == unity gain
  - 2.0 == +6 dB
  - 0.5 == -6 dB
- MovieAudioGain APIs
  - Replace MovieVolume APIs
    - …in conjunction with MovieAudioMute
  - Dispatched to non-AudioContext tracks
  - Gain is not persistent
- kQTAudioPropertyID_Gain is listenable for Movie and Track

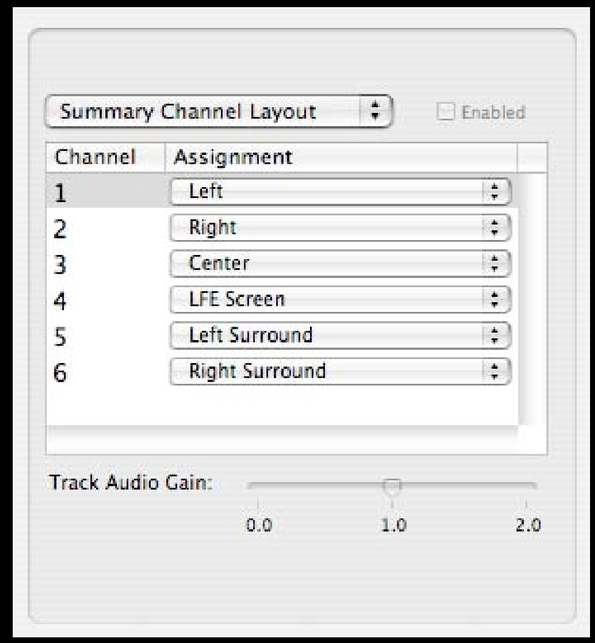
Audio Device Channel Layout

- Device layout for unconfigured devices is stereo
  - Upgrade to QT7.0.1
- Audio MIDI Setup is your friend
  - It's in Applications/Utilities
- Multi-channel layouts trump the stereo pair
- Mono routes to center, if there is one

Audio Routing Panel

Track Overview Pane

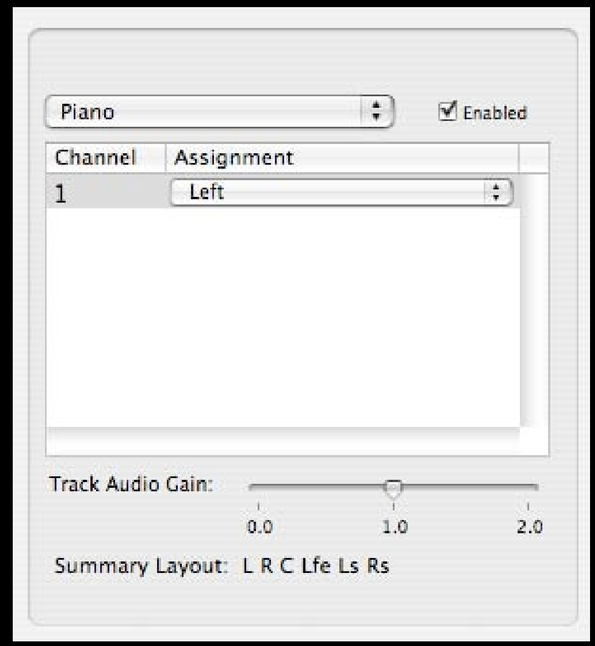
- Movie Summary Channel Layout
  - Collects the spatial contributions of active sound tracks



Audio Routing Panel

Track Overview Pane

- Movie Summary Channel Layout
  - Collects the spatial contributions of active sound tracks
- Sound Track selector
  - Display and edit individual channel labels



Audio Routing Panel

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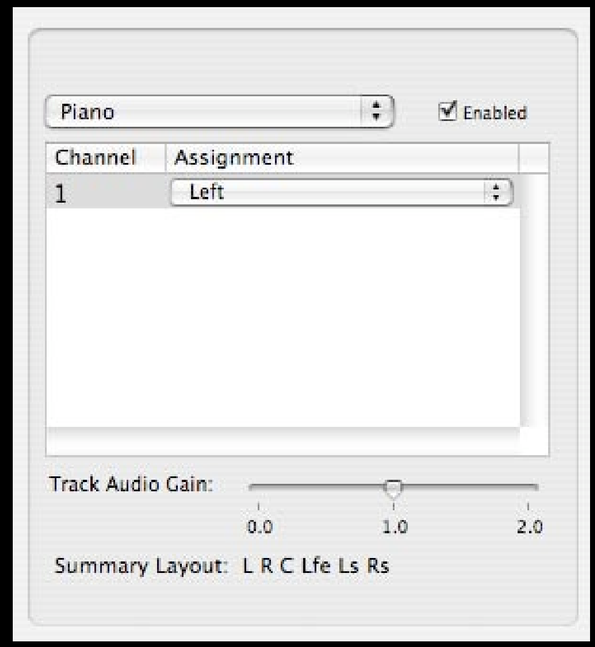
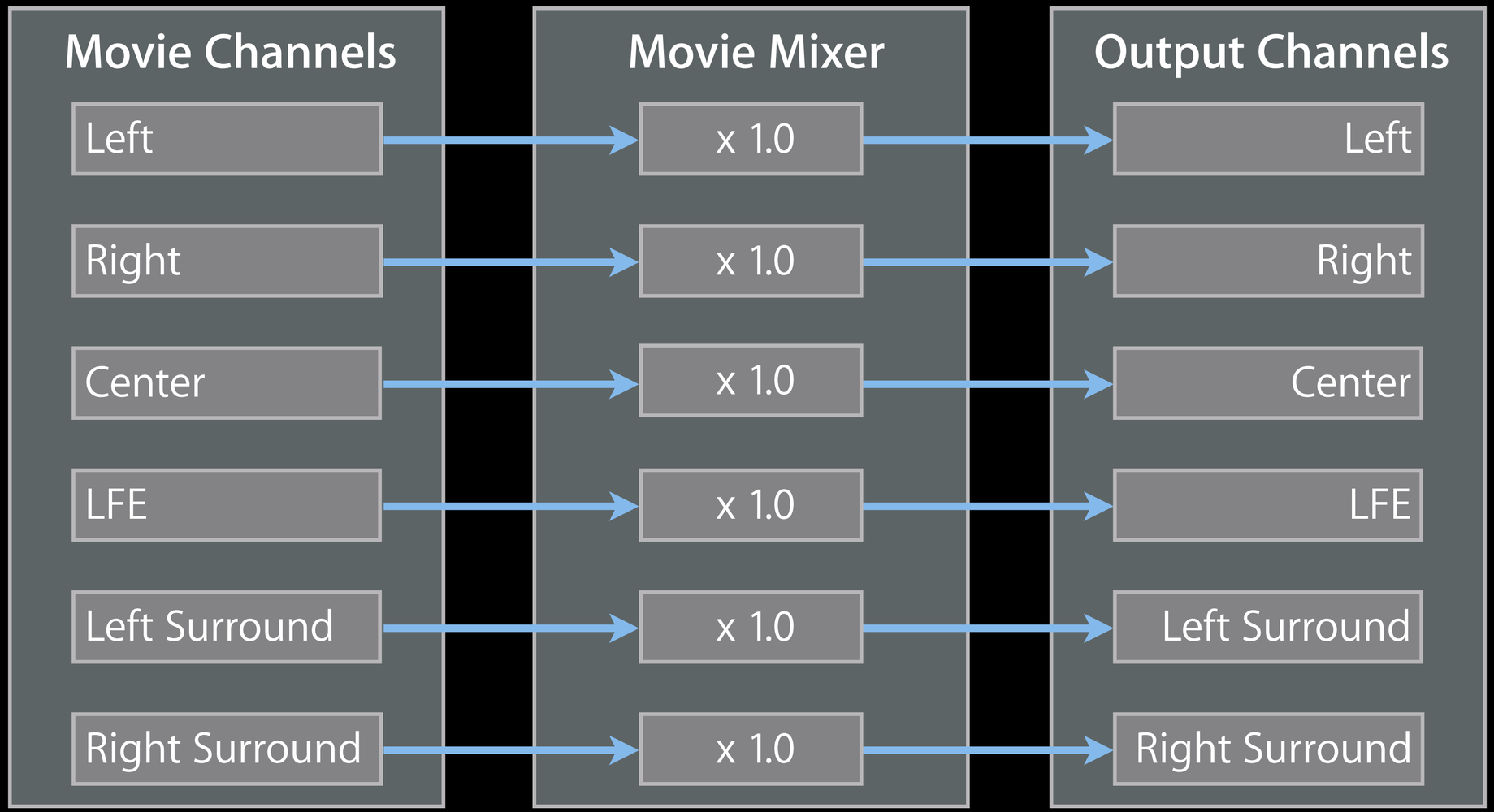


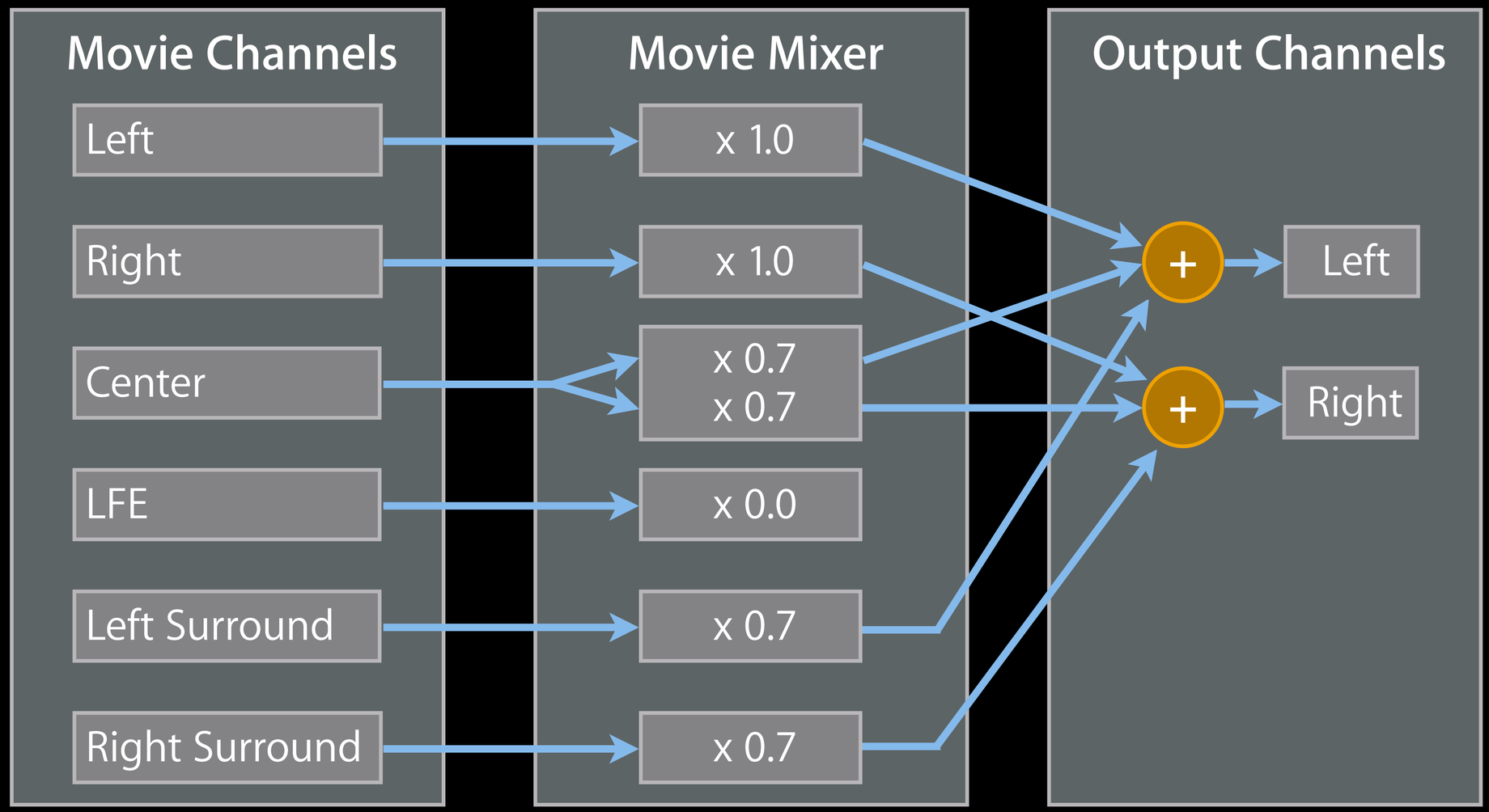
Audio Channel Labels

- Spatial channel labels
  - Defined in `<CoreAudio/CoreAudioTypes.h>`
  - Left, Right, Center, Left-Surround, Right-Surround, LFE, …
- Non-spatial channel labels
  - Mono
    - Routes to Center speaker, if there is one
    - Otherwise, routes to Left and Right speakers
  - Discrete-0, Discrete-1, Discrete-2, etc. route as numbered to device outputs
- Unlabeled content
  - 1-channel == Mono
  - 2-channel == Stereo
  - N-channel == N-channel Mono

Audio Channel Mixing and Routing Example



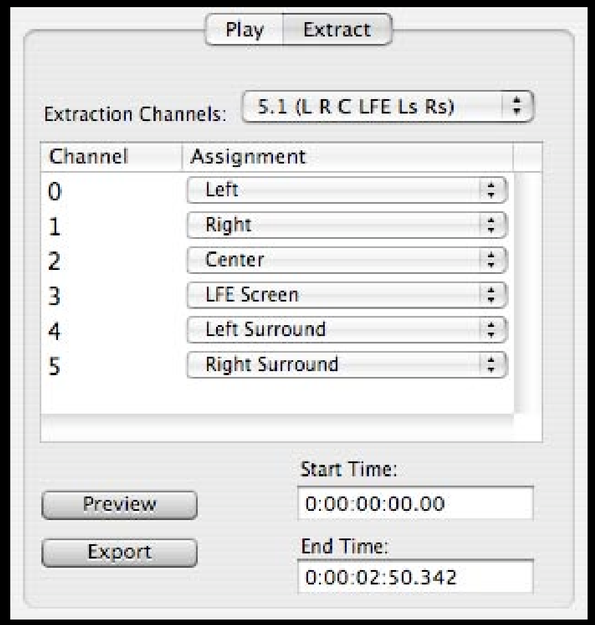
Audio Channel Mixing and Routing Example



Audio Routing Panel

Audio Extraction Pane

- Target channel layout selector
- Display and edit individual channel labels
- Set Start and End times
- Preview the extraction
- Background export to AIFF file



Movie Audio Extraction

- Begin…SetProperty…FillBuffer…End
  - Only participating AudioContext tracks contribute
  - The movie must be active
  - The movie is cloned (`PutMovieIntoHandle`,`NewMovieFromProperties`)
- Initial defaults
  - Movie Summary Channel Layout
    - Get/Set AudioChannelLayout
  - Highest contributing sample rate
    - Get/Set AudioStreamBasicDescription—PCM only
- All Channels Discrete option
  - After setting, re-get ASBD and Layout
  - Set AudioChannelLayout has no effect

Movie Audio Extraction (Cont.)

- Set CurrentTime to set a start location
  - Re-use an extraction session when possible
  - Audio decompression may not be accurately primed
- Extraction past the end of the movie yields silence
  - Use movie or track durations to limit exports
- Movies may be migrated to a thread for background extraction
  - …but only if all codecs are thread-safe (most are)
  - AudioCodec developers, make sure you mark your codecs with the cmpThreadSafe flag if and only if they are indeed thread safe

Audio Capture

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QuickTime Engineering

http://developer.apple.com/wwdc2005/

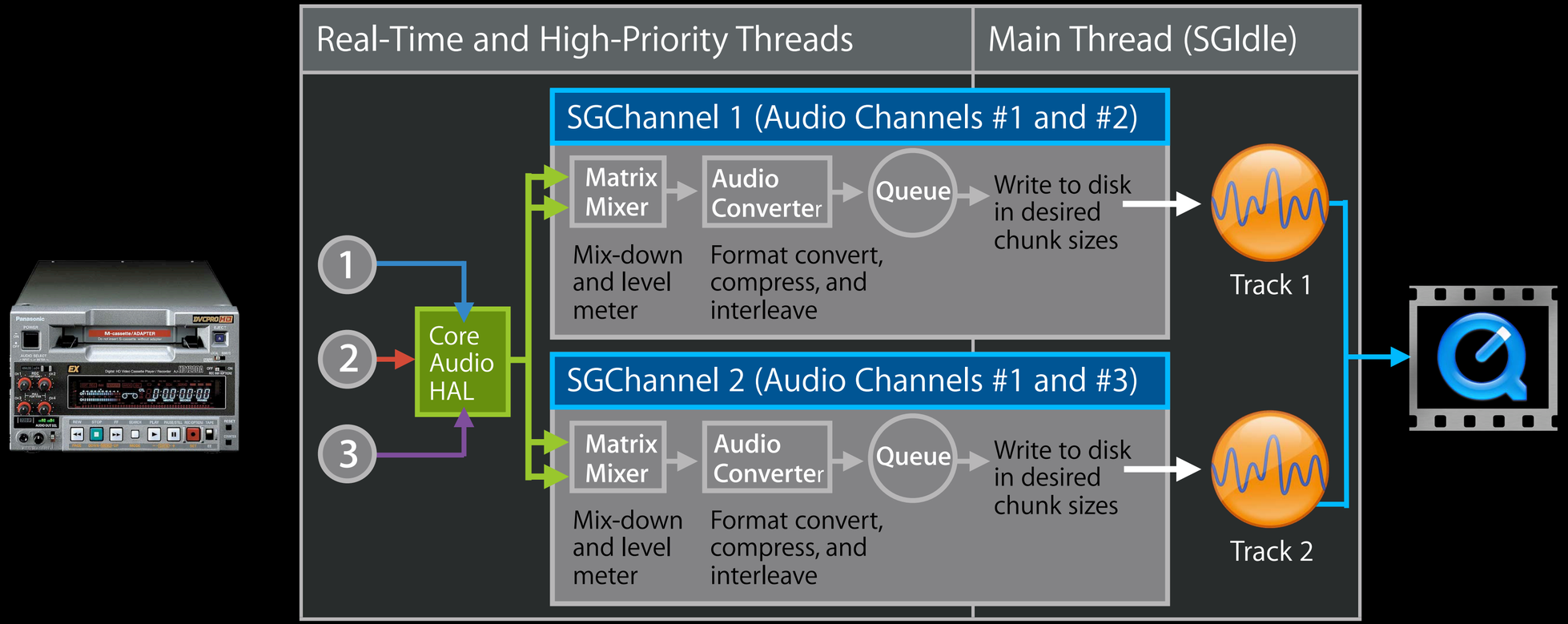
Demo

Multichannel audio capture in Final Cut Pro 5

http://developer.apple.com/wwdc2005/

SGAudioChannel Block Diagram

- Device IO performed on the Core Audio HAL thread
- Mixing, SGAudioCallbacks, and AudioConversion performed on a high priority worker thread
- File-writing performed on the main thread (at SGIdle time)



SGAudioChannel Migration

- Replacement for SGSoundChannel
  - Applications must opt-in
  - SGSoundChannel is in “maintenance mode”
- Configuration leverages Component Property APIs
- No SGSettingsDialog() UI configuration panel
  - See sample code for a basic Cocoa UI

SGAudioChannel Device Support

- Supports DV 25/50 audio capture through Sound Manager (‘sinp’)
  - Caveat: limited to 2 channels at a time (first two, last two, or all four mixed)
- Supports capture from Core Audio devices
  - One input device per SGAudioChannel instance
    - Tiger: an Aggregate Device counts as a single device
  - Caveat: PCM input only (non-mixable format passthru is not supported)

SGAudioChannel Device Support

- Supports real-time preview to Core Audio devices
  - One output device per SGAudioChannel instance
- Multiple SGAudioChannels may be instantiated in a single grab
- Component properties
  - List/select available devices and discover their characteristics
  - Listen for device hotplug events

Sample Code: HackTV

http://developer.apple.com/wwdc2005/

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Sample Code: HackTV

Supports SGAudioChannel
Provides sample SGAudio configuration panel
Uses Decompression Sessions and OpenGL

http://developer.apple.com/wwdc2005/

Sample Code: WhackedTV

Device listing, selection, and hotplug events

http://developer.apple.com/wwdc2005/

SGAudioChannel Device Channel Selection

- Component properties
  - Discover device format (as a flattened stream)
  - Set device format
  - Specify capture of a subset of device channels using a channel map
- Using multiple SGAudioChannel instances, a device's channels may be split among QuickTime movie tracks

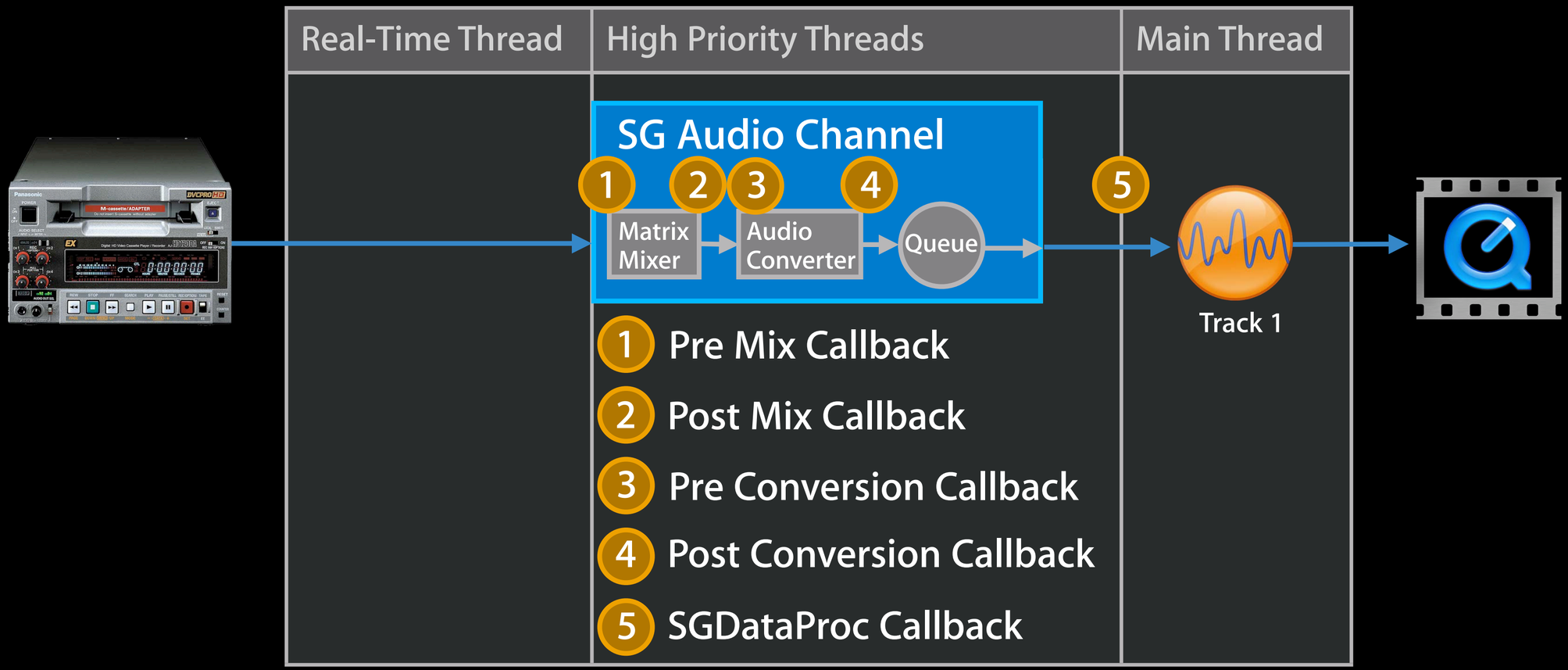
Sample Code: WhackedTV

Setting channel map on record device

http://developer.apple.com/wwdc2005/

SGAudioChannel Exposes its Innards

- SGAudioCallbacks pre- and post-mix, pre- and post-conversion
- Samples are also viewable in the SGDataProc
- Five points in the chain for you to tap in



Sample Code: WhackedTV

Inserting effects Audio Units into SGAudio chain

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SGAudioChannel Flexible Preview

- Component Properties
  - Select hardware (zero-latency) playthru or software preview
  - Specify “what” to preview (pre-mix, post-mix, pre-conversion, or post-conversion)
- Software preview mixes to destination device’s layout automatically

Sample Code: WhackedTV

Specifying what to preview

http://developer.apple.com/wwdc2005/

SGAudioChannel Encodes on the Fly

- By default, PCM audio in the device's format is written to the QT Movie Track
- Component Properties
  - Specify a different output format (SRC, any flavor of PCM, or encodes, including VBR formats such as Apple Lossless and AAC)
  - Specify a different output channel layout than the device's
- Any necessary mixing from device layout to the output layout is handled automatically…
- …or not—Developer may specify matrix mixer crosspoint coefficients via Component Property API to assume full control over the mix

Sample Code: WhackedTV

Specifying an alternate output format and channel layout

http://developer.apple.com/wwdc2005/

Summary

http://developer.apple.com/wwdc2005/

Summary

- QuickTime Player Pro aids in multi-channel content creation
- Audio channel labels inform the Movie Mixer
  - Track channel labels identify the source
  - Device/extraction channel layout identifies the destination
    - Use discretion using discrete labels
- Use movie audio extraction to access the mixed audio
  - Protected content is excluded
- New audio capture capabilities
  - Synchronized multi-channel capture from multiple devices
  - Flexible architecture for mixing, routing, and preview

Documentation, Sample Code, and Other Resources

http://developer.apple.com/wwdc2005/

Related Sessions

Developing and Using Audio Units	Session 203 Tuesday 2:00PM
QuickTime Audio	Graphics and Media Lab Wednesday 9:00AM–12
Core Audio, Audio Units, and OpenAL	Graphics and Media Lab Wednesday 12–6:30PM
QuickTime Feedback Forum	Session 218 Friday 3:30PM

Q&A

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Music Credits

“Well You Needn’t”
By Thelonius Monk
Performed by Daniel Steinberg

“Bantu”
By Andrew York
Performed by Brad Ford

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